MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015/2016

TCS 3311 – COMPILER DESIGN/ TCP2451 – PROGRAMMING LANGUAGE TRANSLATION

(All Sections / Groups)

17 Oct 2015
9 AM – 11 AM.
(2 Hours)

INSTRUCTION TO STUDENT

1. Answer **ALL** questions.
2. This question paper has 4 printed pages excluding the front cover.
3. Please print all your answers in the answer booklet provided.

QUESTION 1

(a) For a regular expression:

lvl | lp | l (l|d)*

Draw a NFA that can recognize the regular expression using Thompson's construction approach. The alphabet set is {l, v, p, d}.

[5 marks]

(b) Explain ε-closure of a state using an example from the NFA you derived in question 1(a).

[4 marks]

(c) Convert the NFA you derived in question 1(a) to a DFA using subset construction method.

[6 marks]

Continued .....

QUESTION 2

(a) Why will left-recursive grammars not work with top-down parsers?

[2 marks]

(b) Study the following grammar:

$S \rightarrow F - S$
$S \rightarrow F$
$F \rightarrow id$
$F \rightarrow [\ S\ ]$

i) Determine if the above grammar is ambiguous. Show how you prove it.

[3 marks]

ii) Determine if the above grammar is suitable for LL(1) parsing. Make any necessary correction to the grammar so that it will be suitable for LL(1) parsing, if needed.

[3 marks]

(c) Draw the LL(1) parsing table for the grammar in question 2(b) (if you made any correction to the grammar in question 2 (b) (ii), make use of your new grammar). Show all your workings clearly.

[7 marks]

Continued .....

QUESTION 3

(a) Given the following grammar:

S→ [P] | D
P → P, P | D
D → #

Draw the DFA to be used to build an LR(0) shift-reduce parser. If there is any conflict, explain the kind of conflict scenario you faced and which state exactly caused the conflict.

[6 marks]

(b) Write a Syntax-directed definition/Attribute grammar for the following BNF grammar so that the data type of the left hand side would match the type of the right hand side of the expression.

<var> → id + <var> | id

[2 marks]

(c) Complete the following Lex specification so that it would be able to return tokens: integer, and identifier. Integer is a list of digits, and an identifier should start with a letter followed by any combinations of letters and digits.

```
%%
DIGIT=      [0-9]
LETTER=     [a-zA-Z]
%%
```

[3 marks]

(d) Implement the following expression as an indirect triples three-address code.

a: b * -c + b * -c

[4 marks]

Continued.....

QUESTION 4

a) Algebraic simplifications, constant folding, eliminating redundant loads and stores are examples of peephole optimizations. Elaborate how they work with examples.

[6 marks]

b) Explain the process taken by a code generator when it visits a declaration.

[4 marks]

c) Illustrate with examples the scoping of variables in the following situations:

i. Scope of variables in statement blocks
ii. Scope of global variables
iii. Scope of external variables
iv. Scope of formal arguments of functions
v. Scope of labels

[5 marks]

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